CERES FM1 – FM5 Instrument Status

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CERES Science Team Meeting
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La Jolla, CA
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CERES Instrument Operations

All CERES instruments (FM1 – FM5) were in normal Crosstrack mode of operations during the Government Shutdown Period.

ICM Calibrations using on-board sources (Blackbody – 3 times/wk, SWICS – weekly) were performed.

Operations involving azimuthal rotation (Solar Calibrations, Along-track scanning, Lunar view scans) were suspended, expect for the ones already scheduled for Oct 1-2, on S-NPP/ CERES FM5.

Level-0 data processing and analysis were done to monitor the health of the instruments.

Suomi NPP/CERES FM5 Status

CERES Flight Model 5 Instrument completed 21 months of on-orbit operations after the main-covers opened.

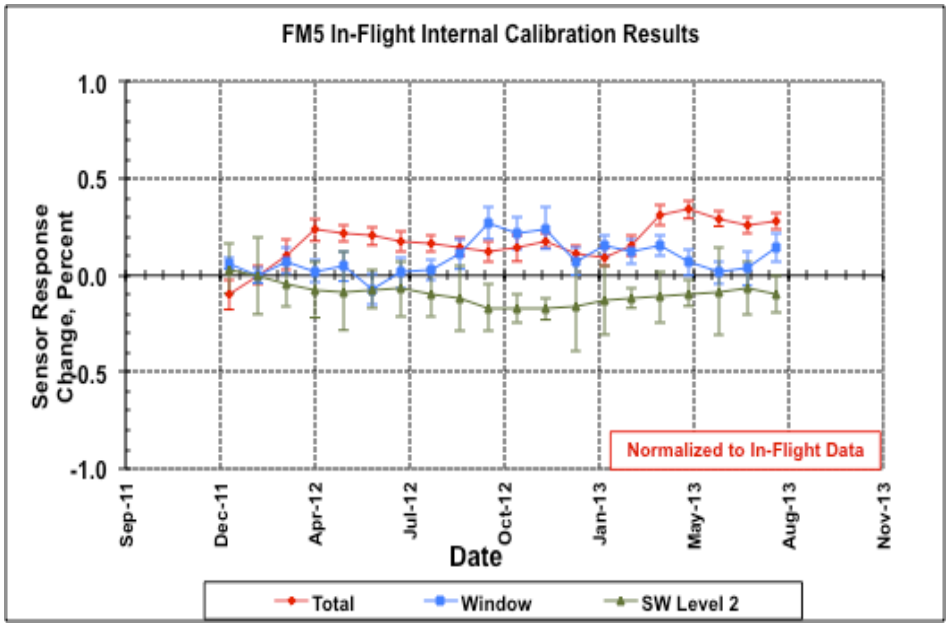
Operations:

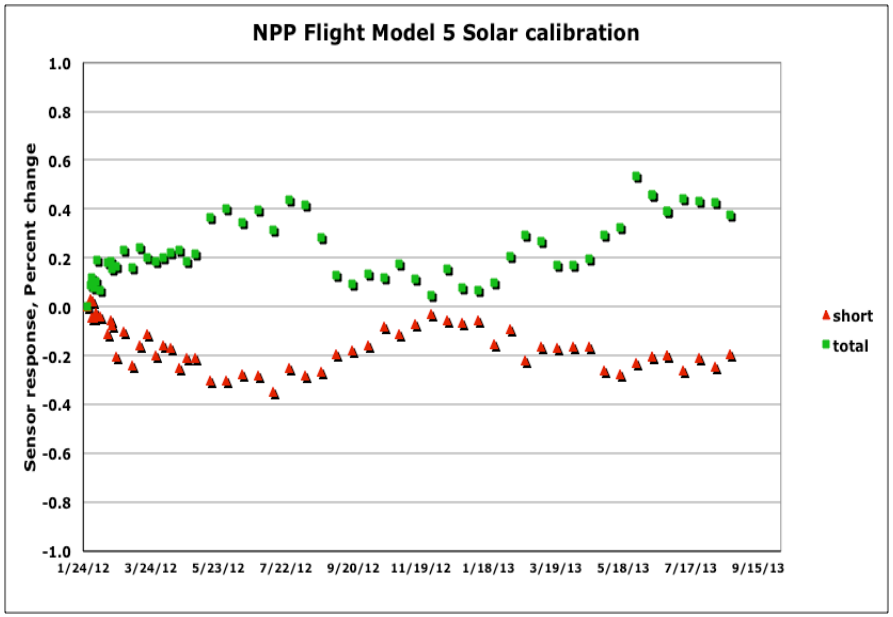
- **Command to raise the Bridge Balance Set point Range for SW sensor to address the higher drift rate.**
- **Increase the set elevation angles for monthly lunar observations to avoid the corruption in the measurements due to reflection from spacecraft structure.**

Sensor Performance is evaluated with ICM Calibrations using on-board sources and Solar calibrations.

Suomi NPP/CERES FM5 Calibration Results

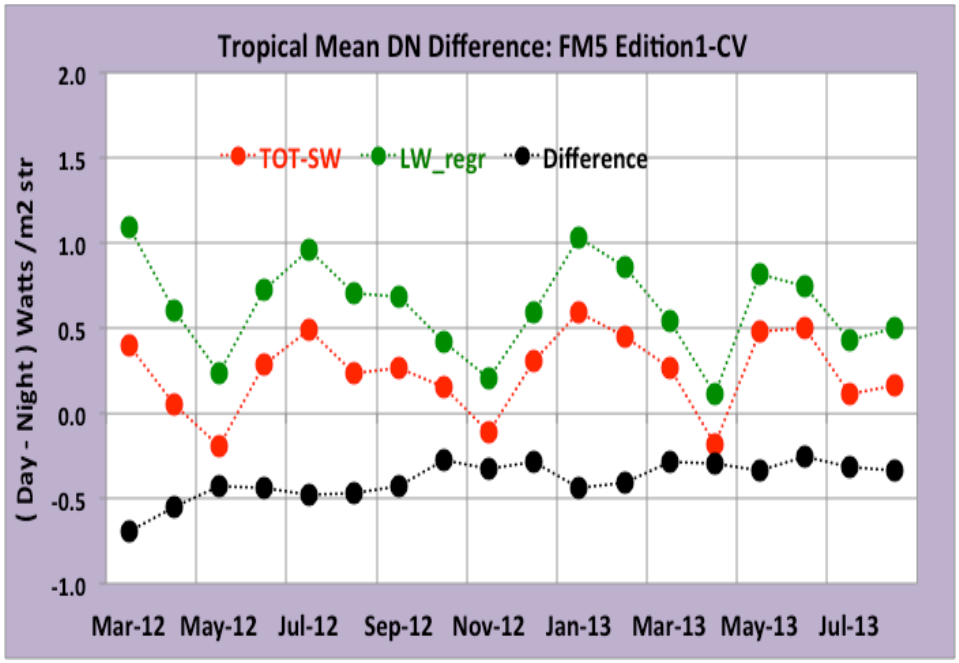
The on-orbit performance of all three sensors are within the expected range of +/- 0.5 percent during the 21 months in mission.



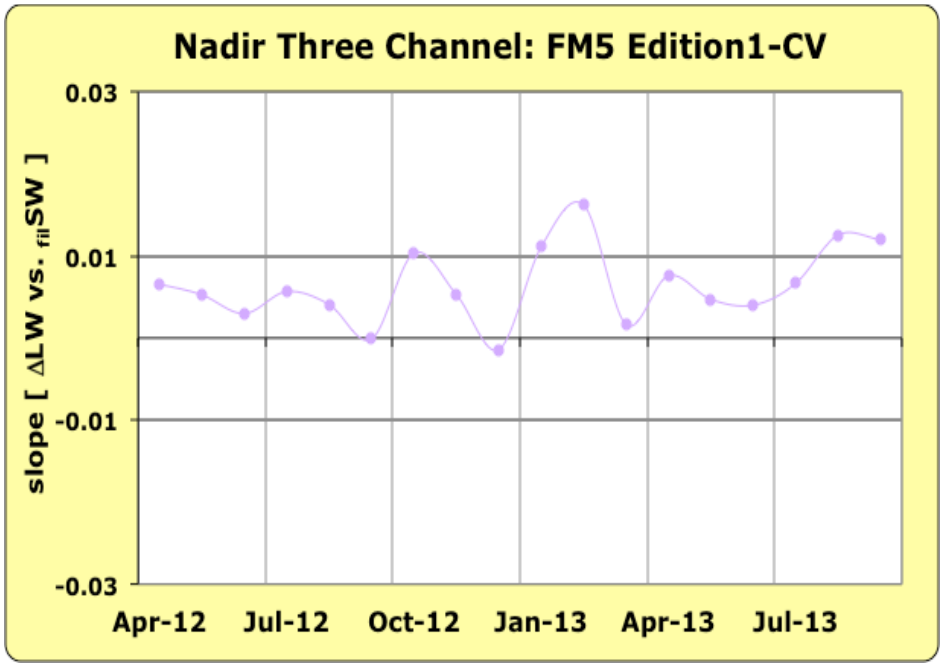


Suomi NPP/CERES FM5 Validation Trends

Tropical Mean: D-N Difference Measured LW and WN-Derived LW



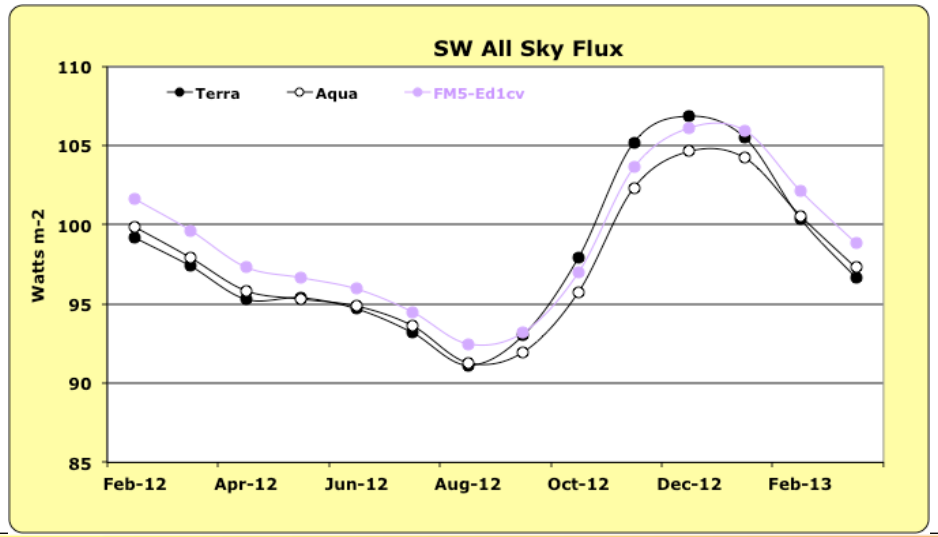
3 Channel Comparison using DCC

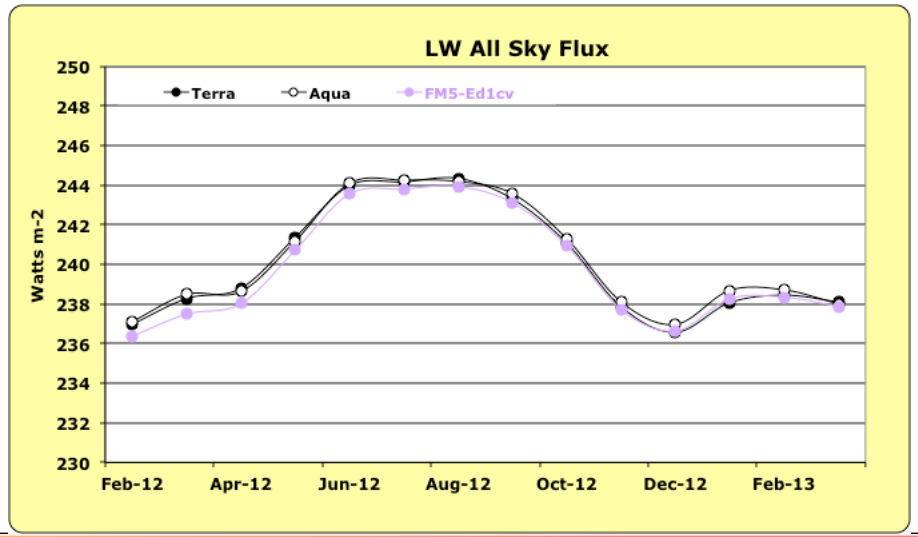


CERES FM5 Validations – Global Flux Comparison

Comparison with CERES FM1 and FM3 [Feb 12 – Mar 13]

	FM5 Wm-2	FM1 Wm-2	FM5-FM1 Wm-2	FM3 Wm-2	FM5-FM3 Wm-2
LW_All	239.77	240.1	-0.32	240.24	-0.47
SW_All	97.20	96.23	0.94	95.85	1.4





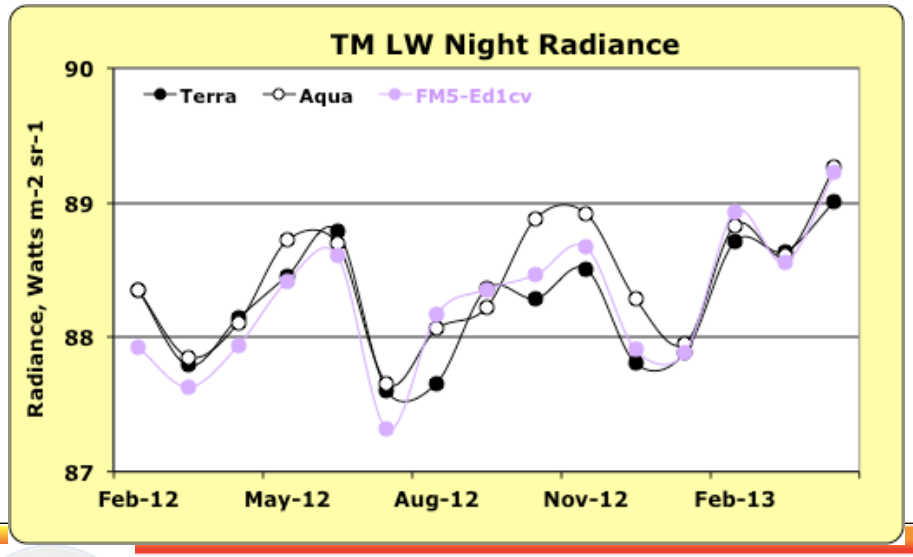
D. R. Walikainen

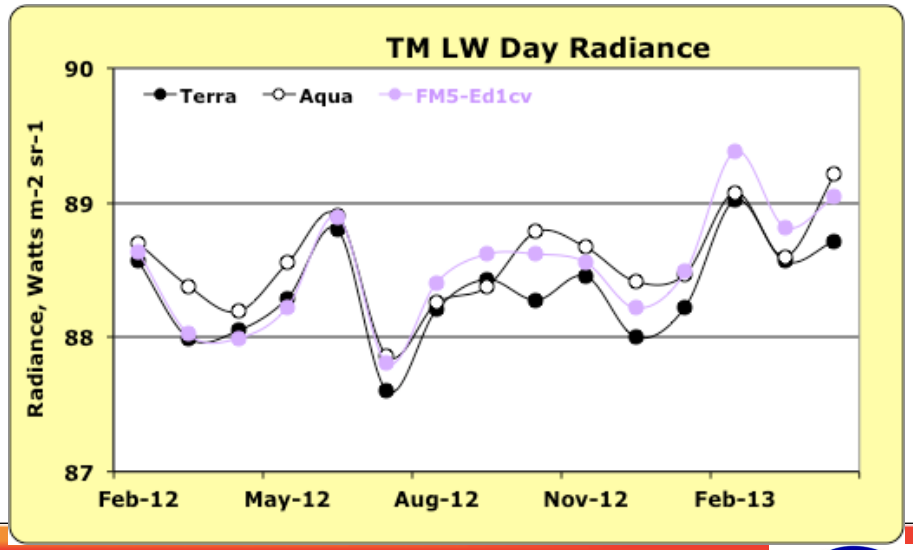
CERES FM5 Validation – Tropical Mean Comparison

Average of All-sky Tropical ocean(20°N-20°S) Radiance

Comparison with FM1 and FM3 (Feb 12 – Apr 13)

	FM5 Wm-2sr-1	FM1 Wm-2sr-1	FM5-FM1 Wm-2sr-1	FM3 Wm-2sr-1	FM5-FM3 Wm-2sr-1
LW-night	88.13	88.16	-0.03	88.33	-0.20
LW-Day	88.33	88.27	0.06	88.48	-0.15





CERES FM5 (NPP) –FM3 (Aqua) Comparisons

- NPP and Aqua Simultaneous Observation Opportunities occur every 64 hours and last ~20 minutes with views < 1 minute apart.
- Comparison based on gridded 1° x1° averages with relative VZA <15 deg and RAZ < 10 deg.

All-sky Results: Feb 2012– March 2013

(FM5-FM3)/ FM5	FM5 Radiance [W m^{-2} sr^{-1}]	Relative Difference [%]	α-confidence	Number of samples
Shortwave	**80.53**	**3.16**	**0.44**	**82**
LW day	**75.96**	**-1.39**	**0.13**	**84**
LW night	**67.79**	**-0.50**	**0.11**	**102**

- Additional scene comparisons – Clear Ocean, Clear Land, Overcast – showed FM5 SW is measuring higher (1.8 – 2.99 Wm-2sr-1.)

CERES FM5 (NPP) –FM3 (Aqua) Comparisons

Nadir dwell scan profile:

Radiance average is based on 330 samples.

Azimuth gimbal is set same as the cross-track mode (180 deg)

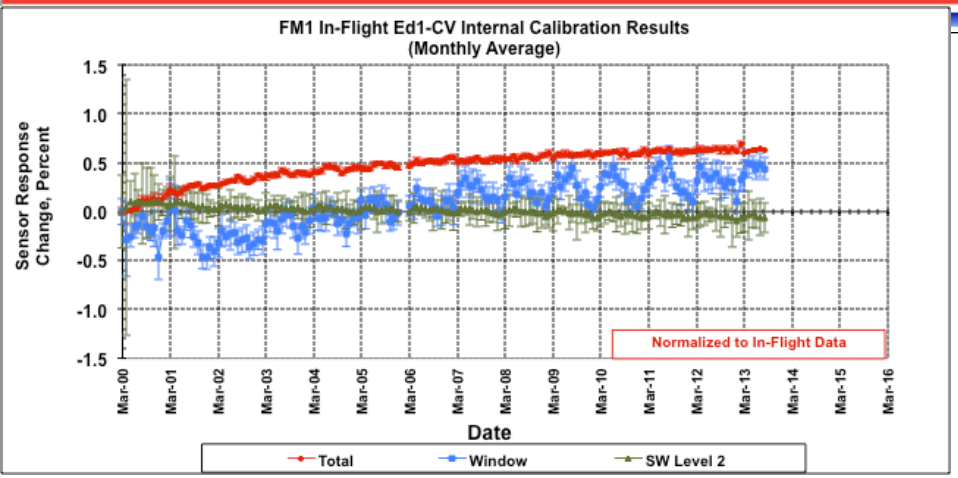
Eight matched scans/min and up to 2 min of matched sites.

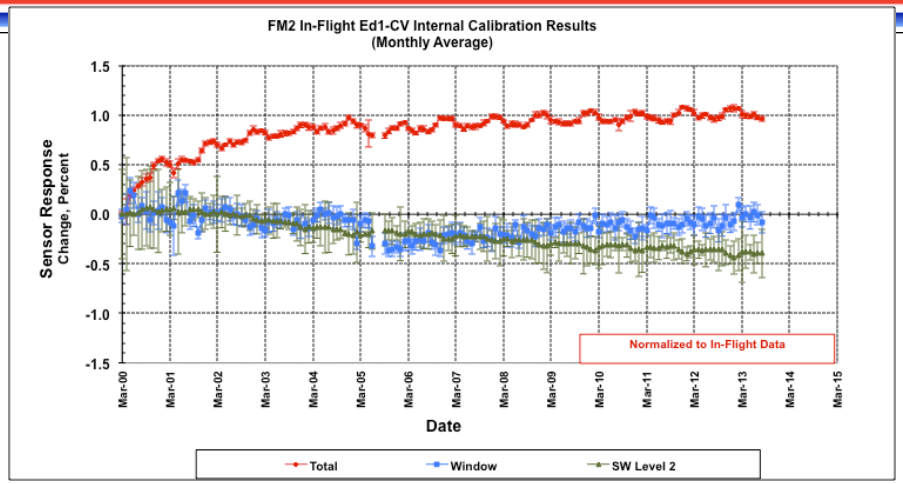
Date	LAT/LON	Time	Scene
Feb 17	**74 S 153 E**	**Day**	**Land**
June 14	**70N 120W**	**Night**	**Land**
July 17	**60N 130W**	**Night**	**Ocean**
Aug 20	**50S 150E**	**Day**	**Ocean**
Oct 1	**40S 70W**	**Day**	**Land**

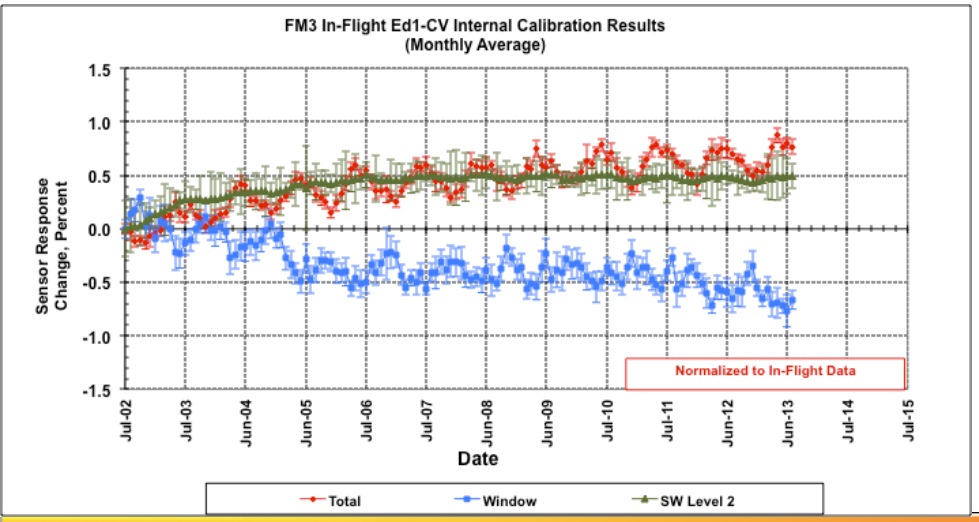
TERRA & AQUA INSTRUMENT STATUS

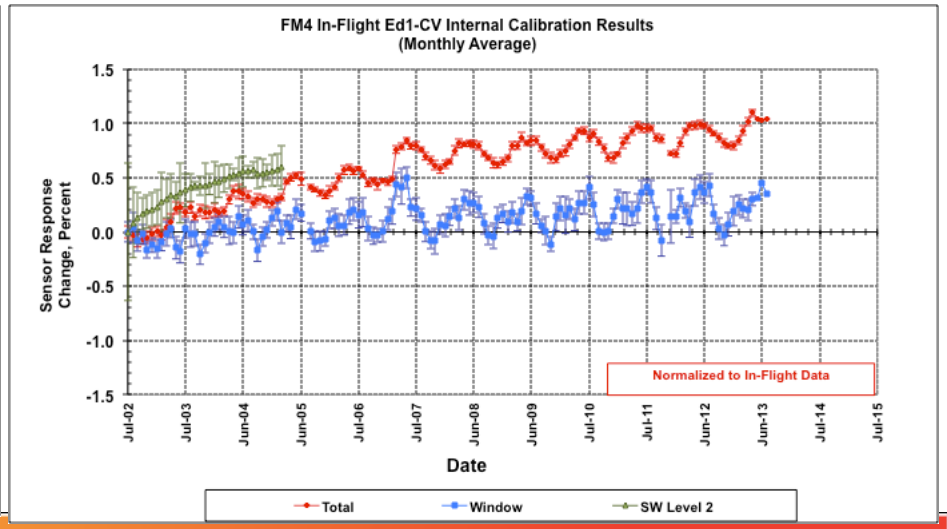
[CERES FM1 – FM4]

Terra – Aqua Sensor Performance









TERRA/AQUA DATA AVAILABILITY

Edition1-CV Data Products (Instrument & ERBE-like):

Start of Mission – September 2013

Edition3 Data Products (Instrument):

Start of Mission – June 2013

Edition4 Gains and Spectral Response Functions (SRF) :

Terra: Delivered - Start of Mission to Dec 2009

Aqua: In testing - Start of Mission to Dec 2009

TERRA EDITION-4 Updates

Start of Mission Gain and SRF remain same as Edition3

The monthly gain values for the Total, Window and Shortwave sensors are based on the in-flight ICM calibrations.
In Ed4, SW gains were applied based on the SWICS results.

The monthly SRF changes are applied to SW sensor and SW/TOT sensor of the instrument. The approach is same as Edition3.

FM2 Radiometric Scaling Factor for Ed4 Processing

	Shortwave	Window	Total	Total (<3µm)
FM2	-0.01%	0.2%	0.28%	-0.22%

TERRA/AQUA SW Spectral Response Correction

Assumption:

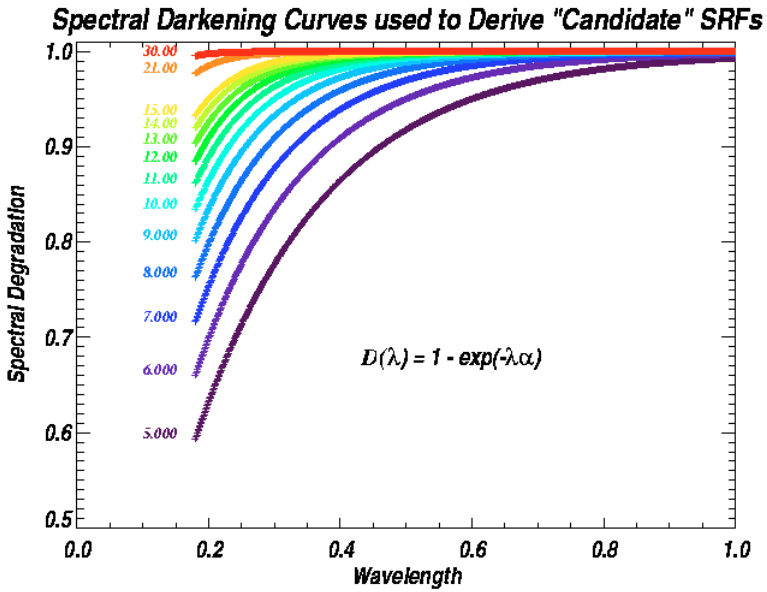
Temporal variation in the SW unfiltered radiance ratio is due to spectral degradation.

Spectral degradation occurs only on RAPS instrument

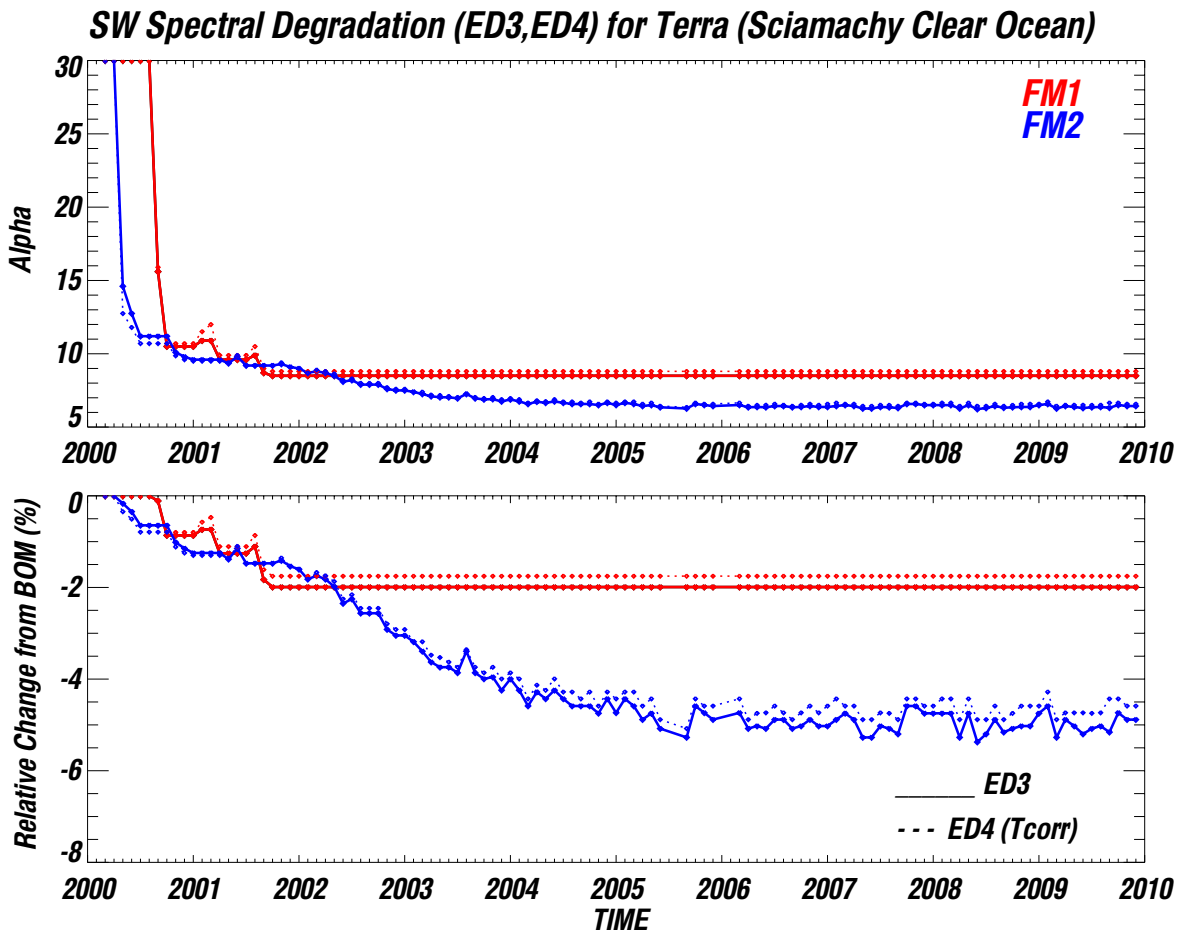
Approach:

The best SRF is selected from 'candidate' set of SRFs to correct spectral darkening for the instrument operating in RAPS mode, such that the monthly SW unfiltered radiance ratio remain constant throughout the mission.

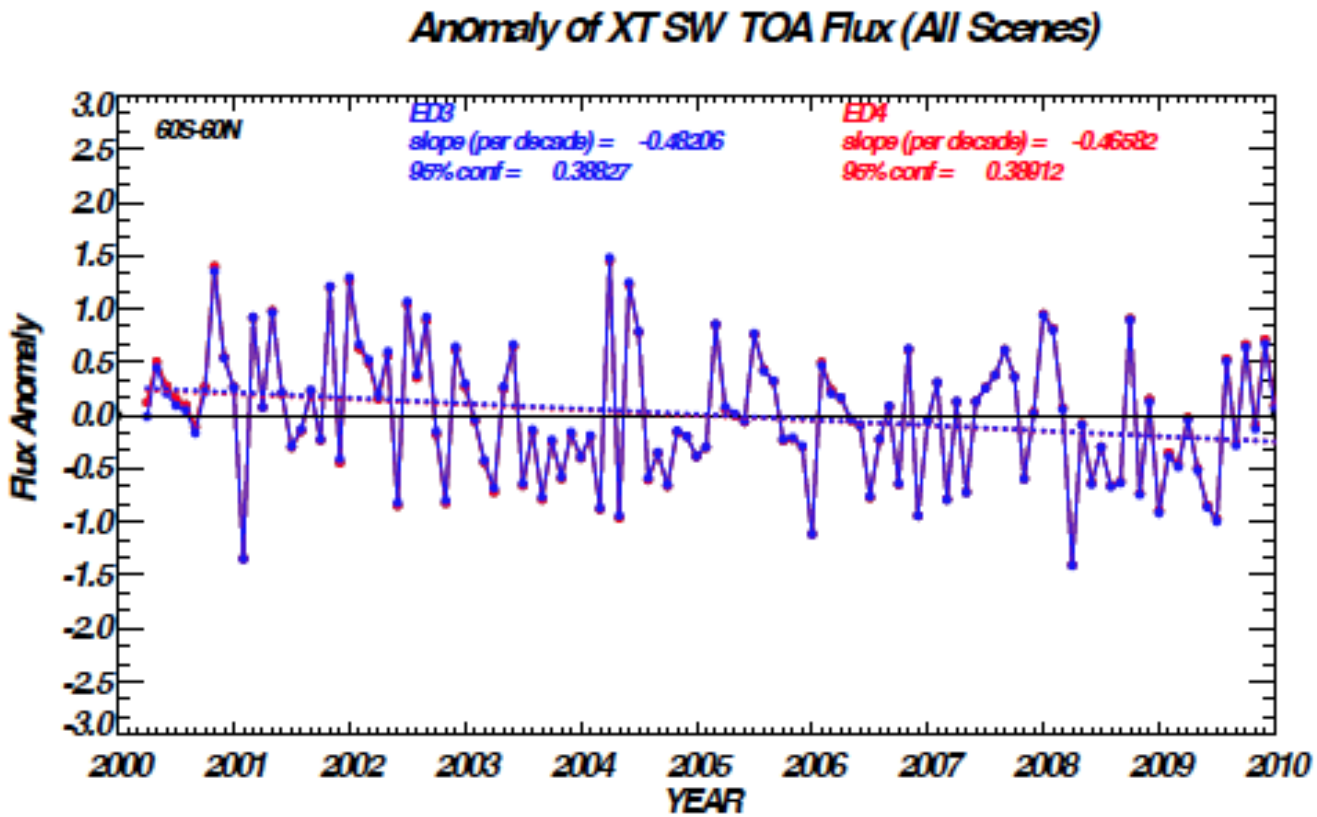
No correction is applied to the instrument in cross-track mode.



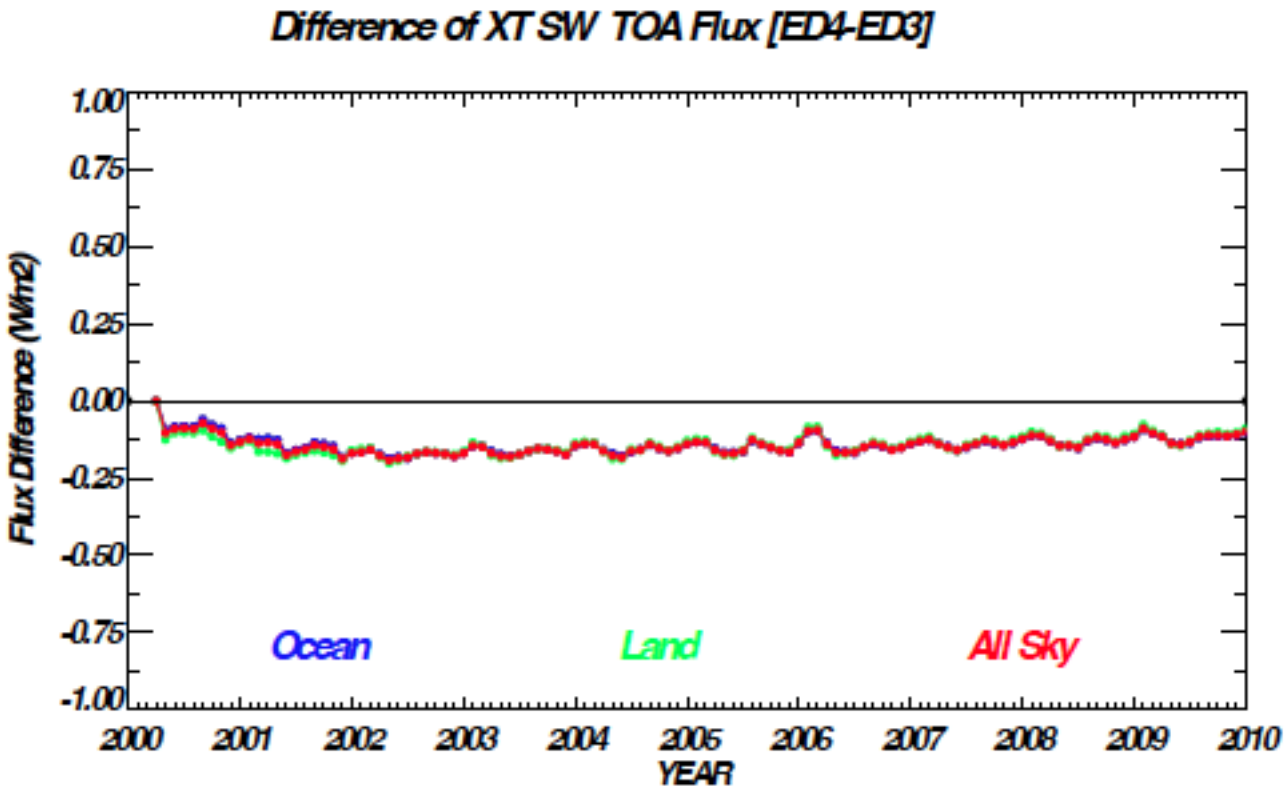
TERRA EDITION-3 and 4 SW Correction



TERRA EDITION-3 and 4 SW Comparison

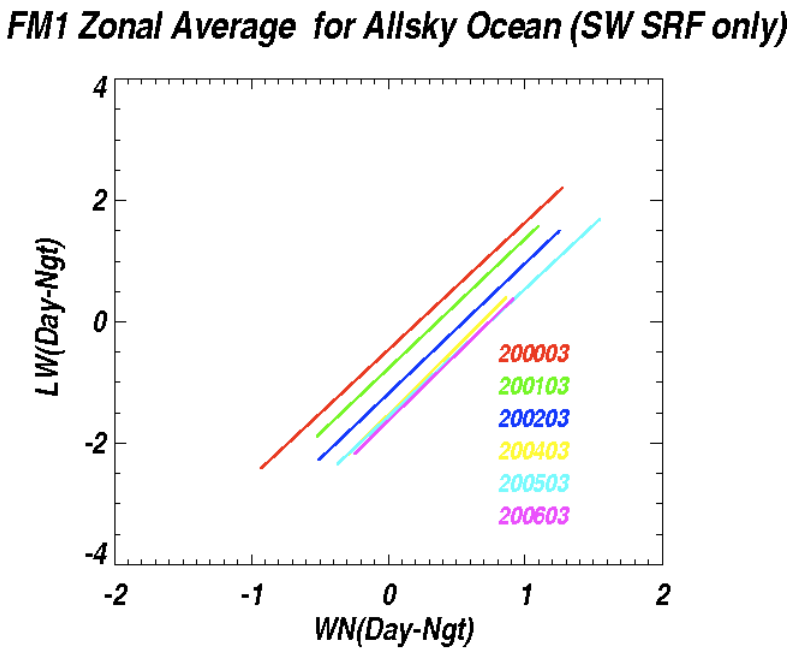


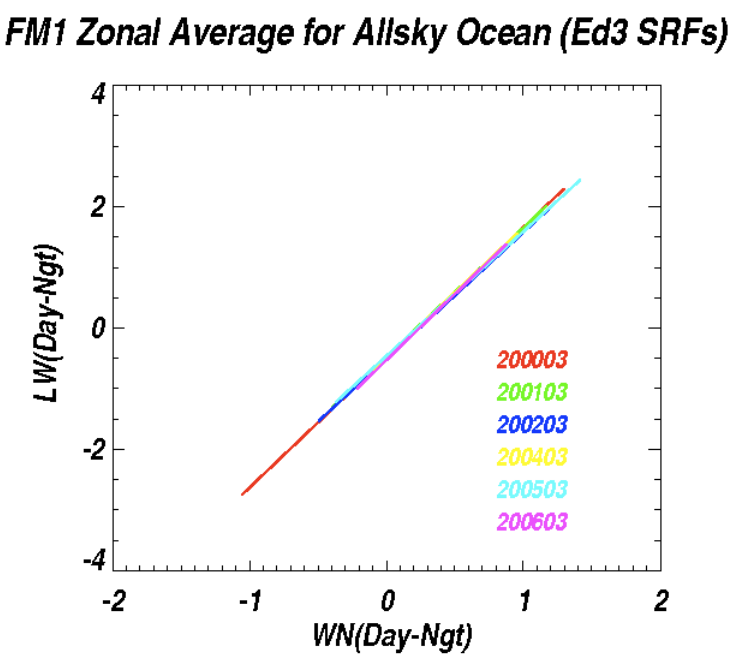
TERRA EDITION-3 and 4 SW Comparison



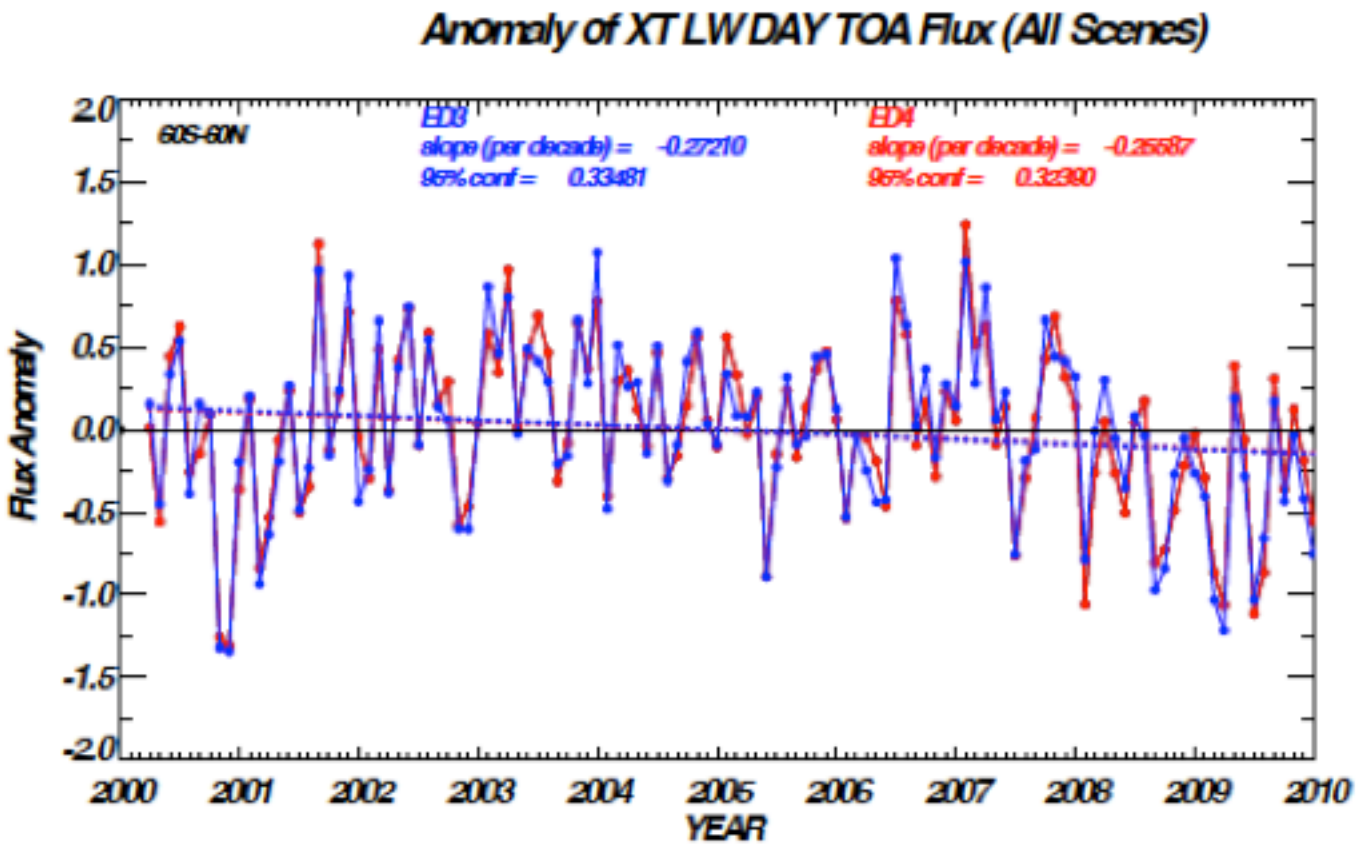
TERRA/AQUA SW/TOT Spectral Response

- All-Sky Ocean averages in the 30N – 30S region.
- Window and LW Day - Night difference regression.
- The best SRF is selected from 'candidate' set of SRFs with the spectral darkening correction, which will eliminate the monthly offset from Beginning of Mission (BOM).

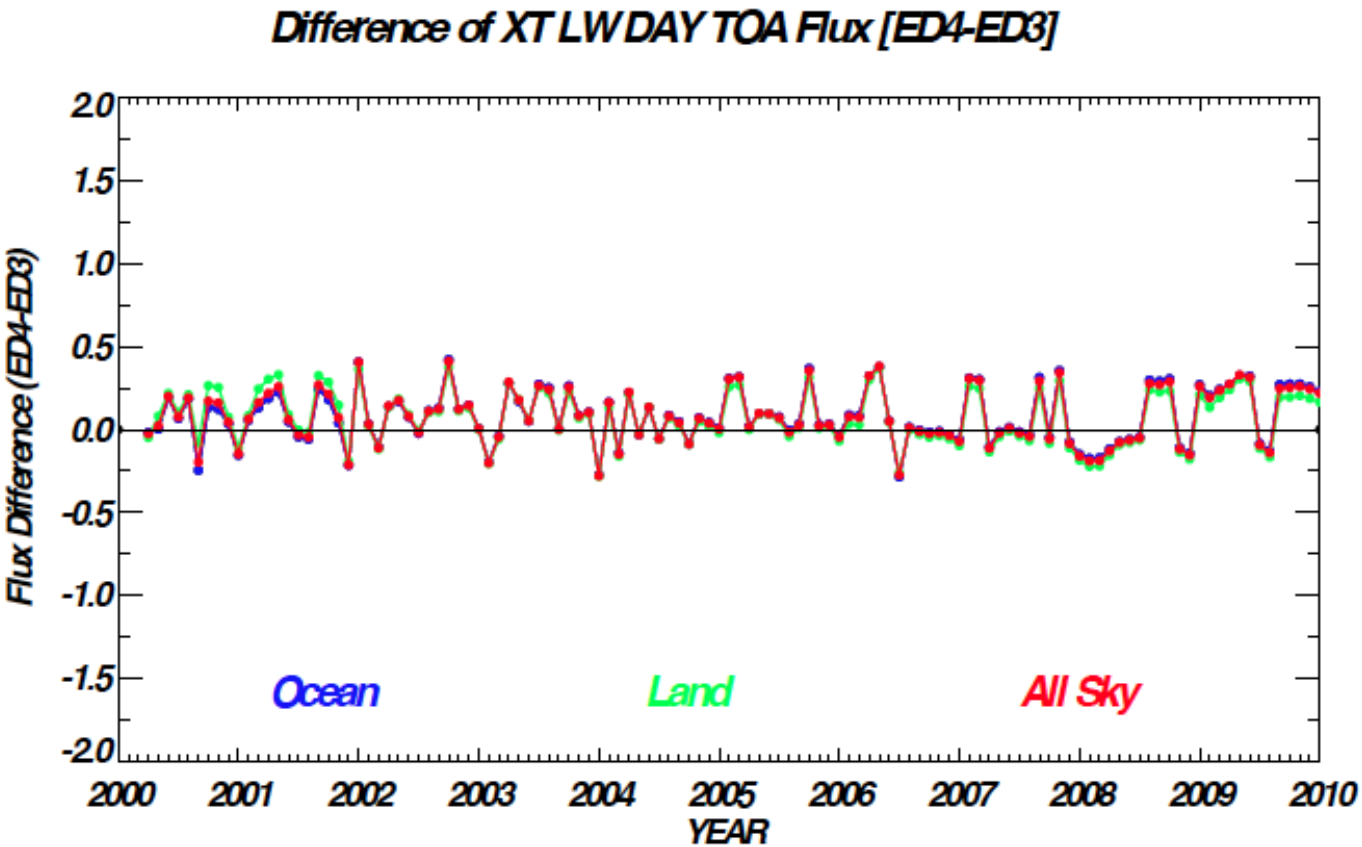




TERRA EDITION-3 and 4 LW Comparison



TERRA EDITION-3 and 4 LW Comparison



AQUA Edition-4: Updates

Start of Mission Gain remain same as Edition3.
Start of Mission SRF for FM3 instrument was updated.

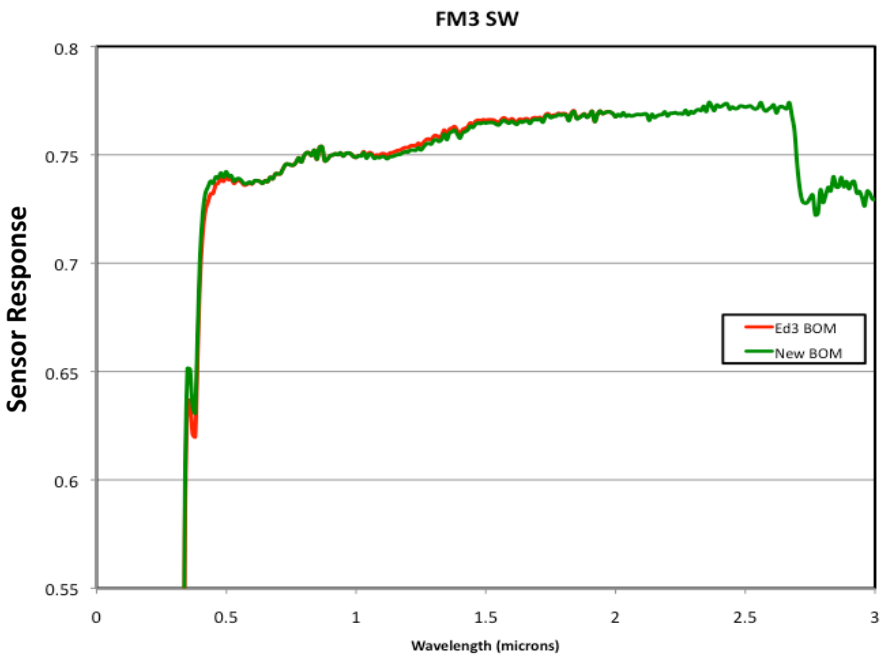
The monthly gain values for the Total, Window and Shortwave sensors are based on the in-flight ICM calibrations.

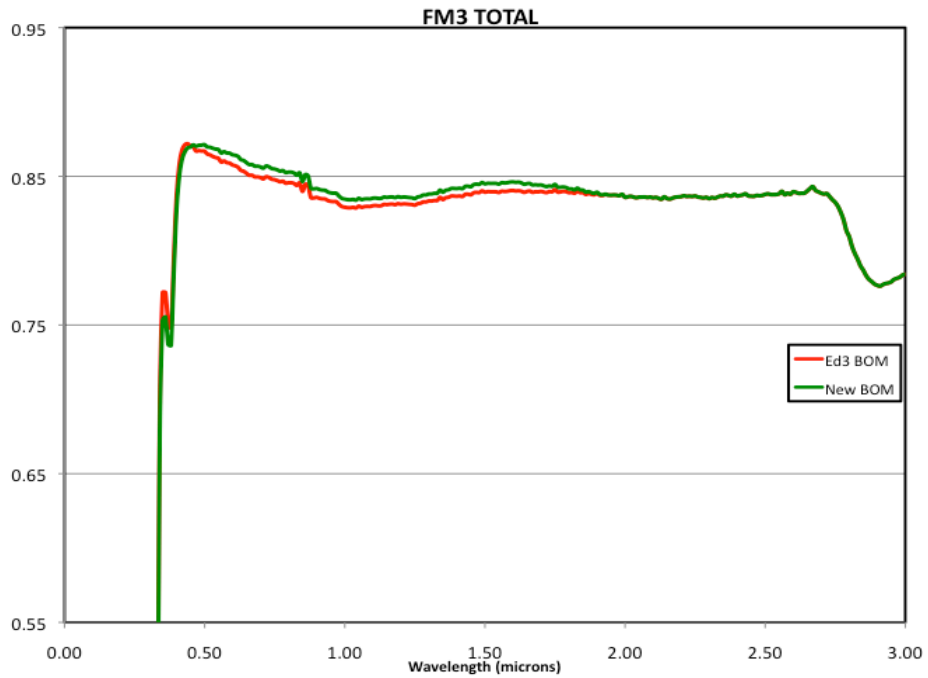
FM3 and FM4 Radiometric Scale Factor was calculated.

	Shortwave	Window	Total	Total (<3µm)
FM3	0.15%	0.3%	1.57%	4.12%
FM4	0.35%	-0.2%	1.84%	4.19%

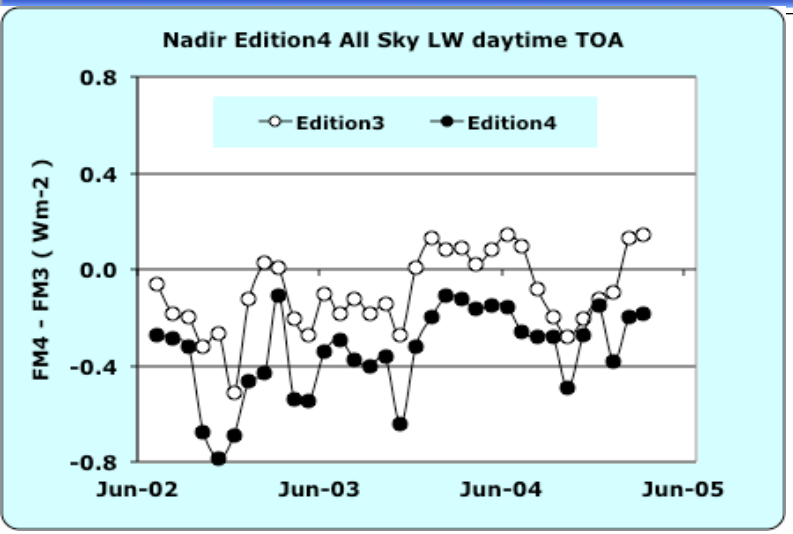
AQUA Ed4: Beginning-Of-Mission SRF

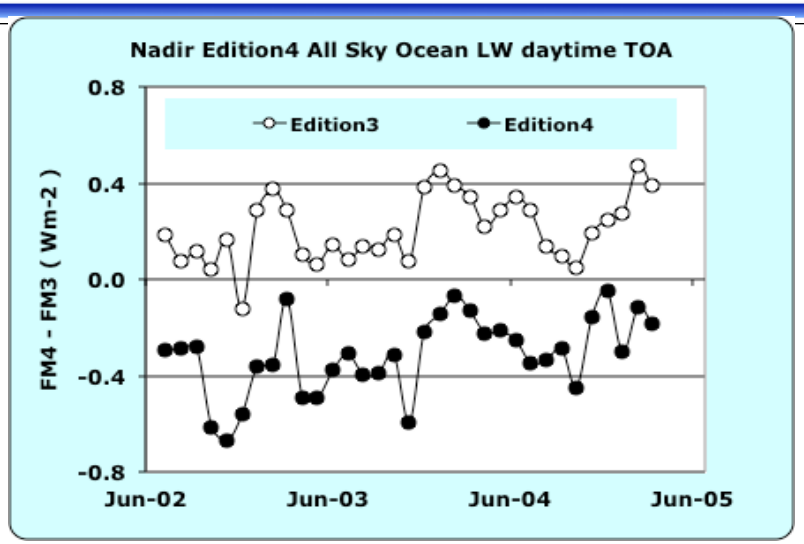
The Beginning-of-Mission (BOM) Spectral Response Functions (SRF) for the Aqua Instruments (FM3 and FM4) were evaluated.
The SW and SW/TOT on FM3 was corrected, causing a reduction in the dispersion seen in FM3 and FM4 comparison for Land and Ocean scenes.

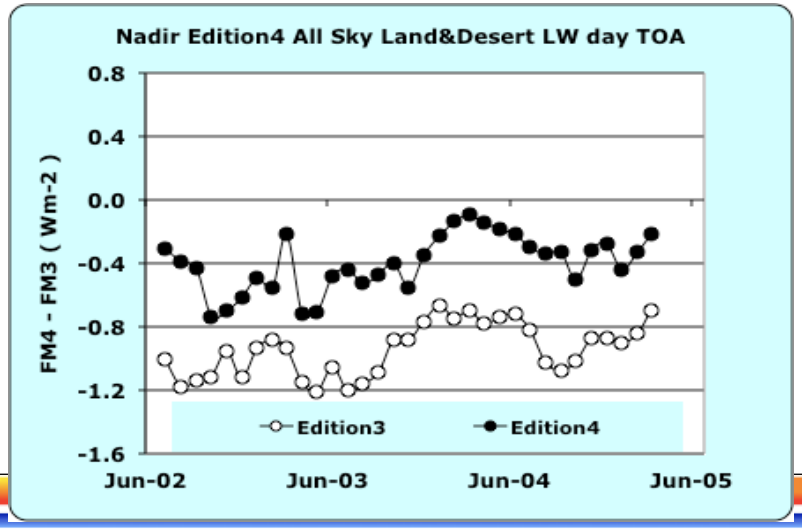




AQUA LW_Day Comparison



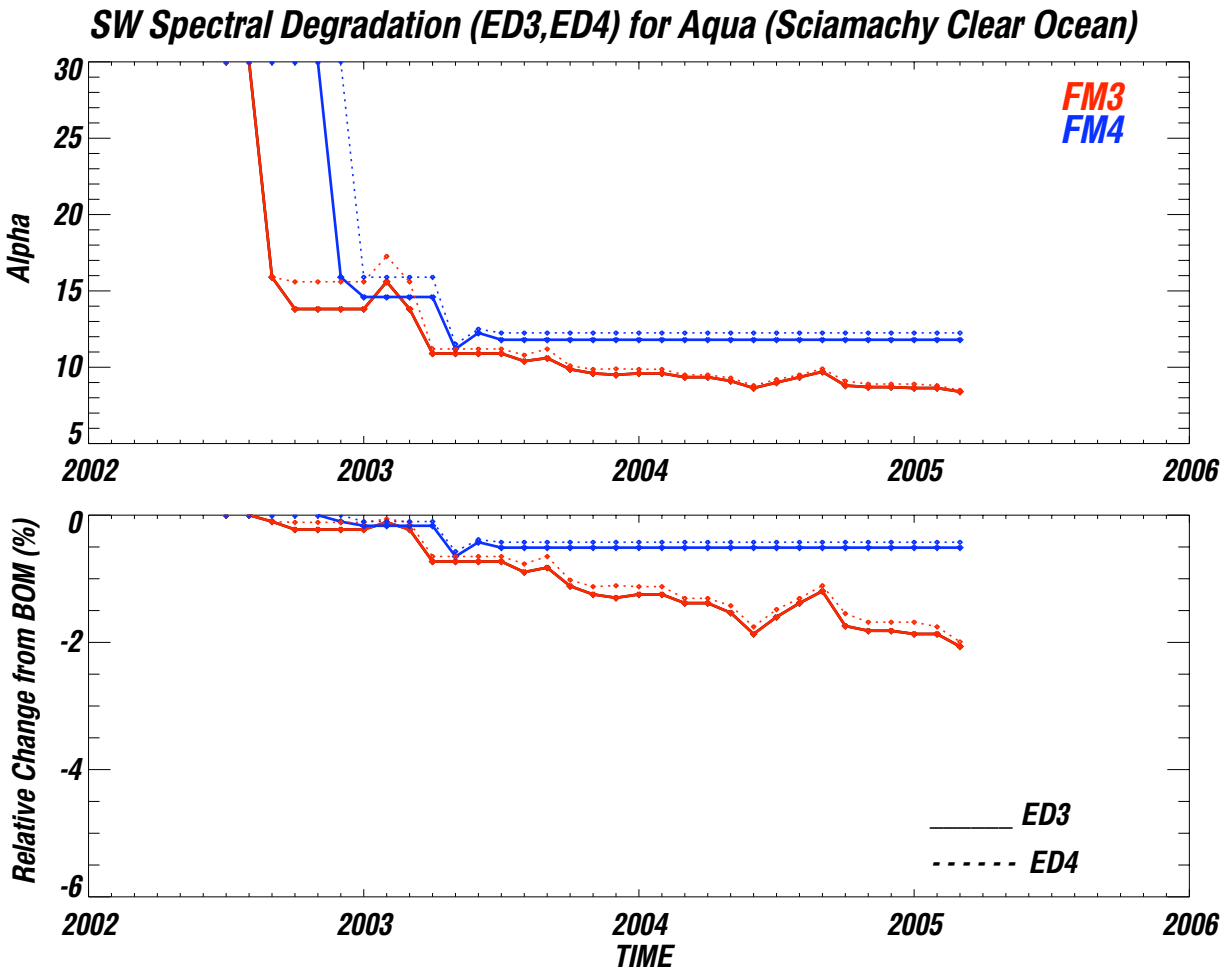




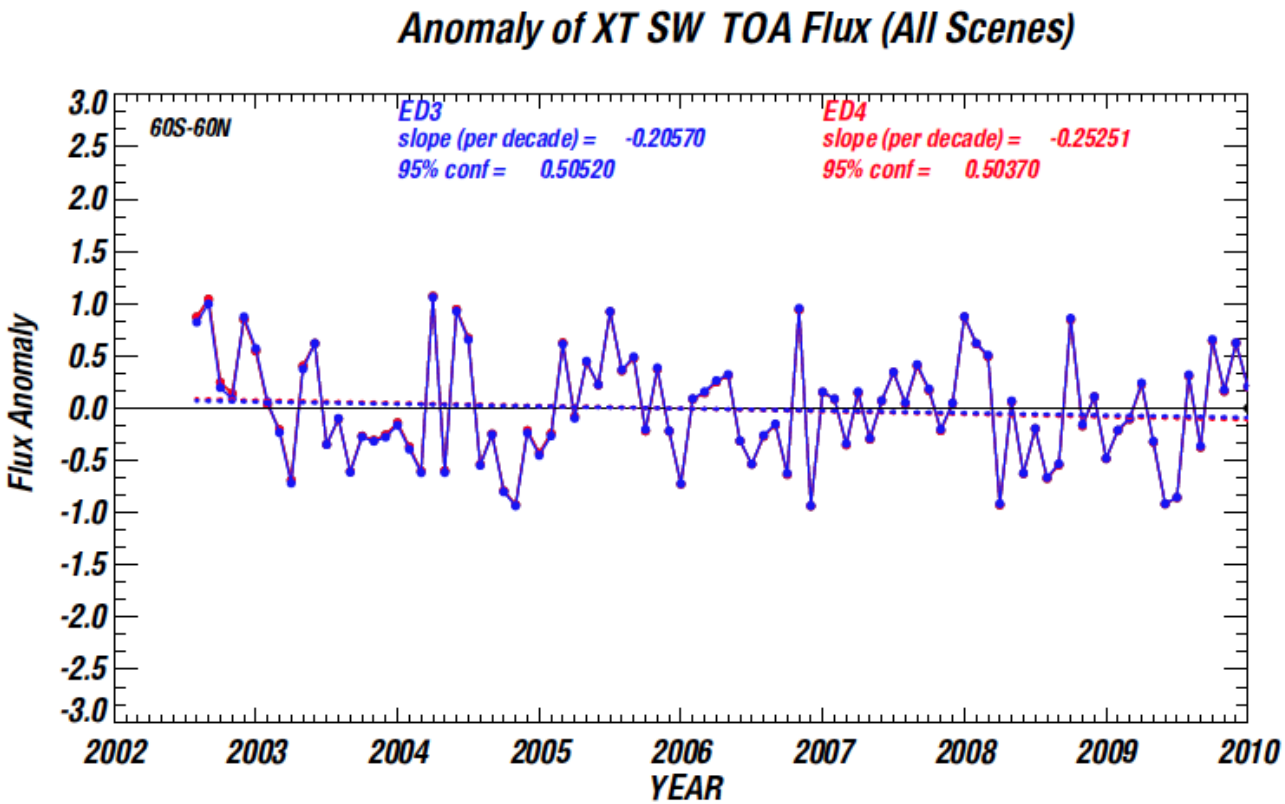
FM4-FM3 Flux Difference Wm-2 (Jul '02)

	Edition3	Edition4
All-sky	-0.06	-0.27
All-Ocean	0.19	-0.3
All-Land	-1.01	-0.31

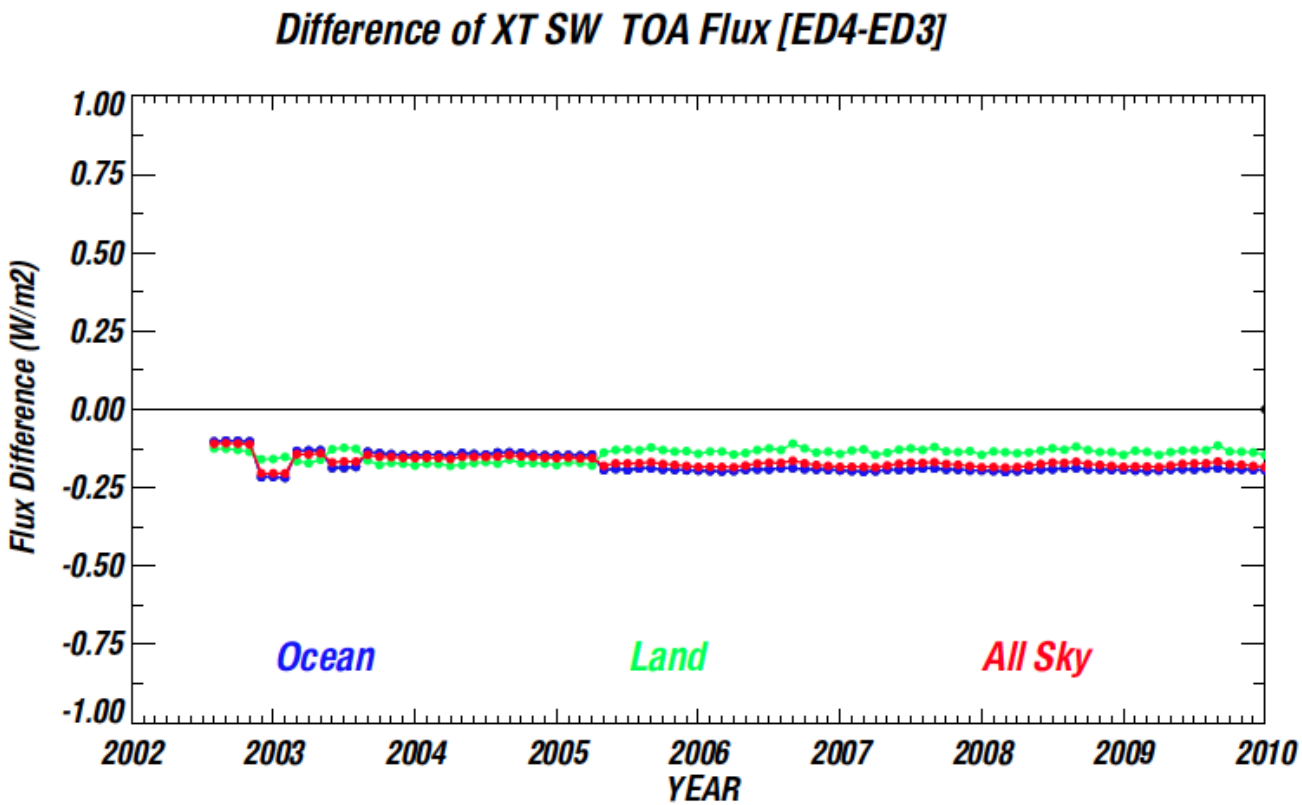
AQUA EDITION-3 and 4 SW Correction



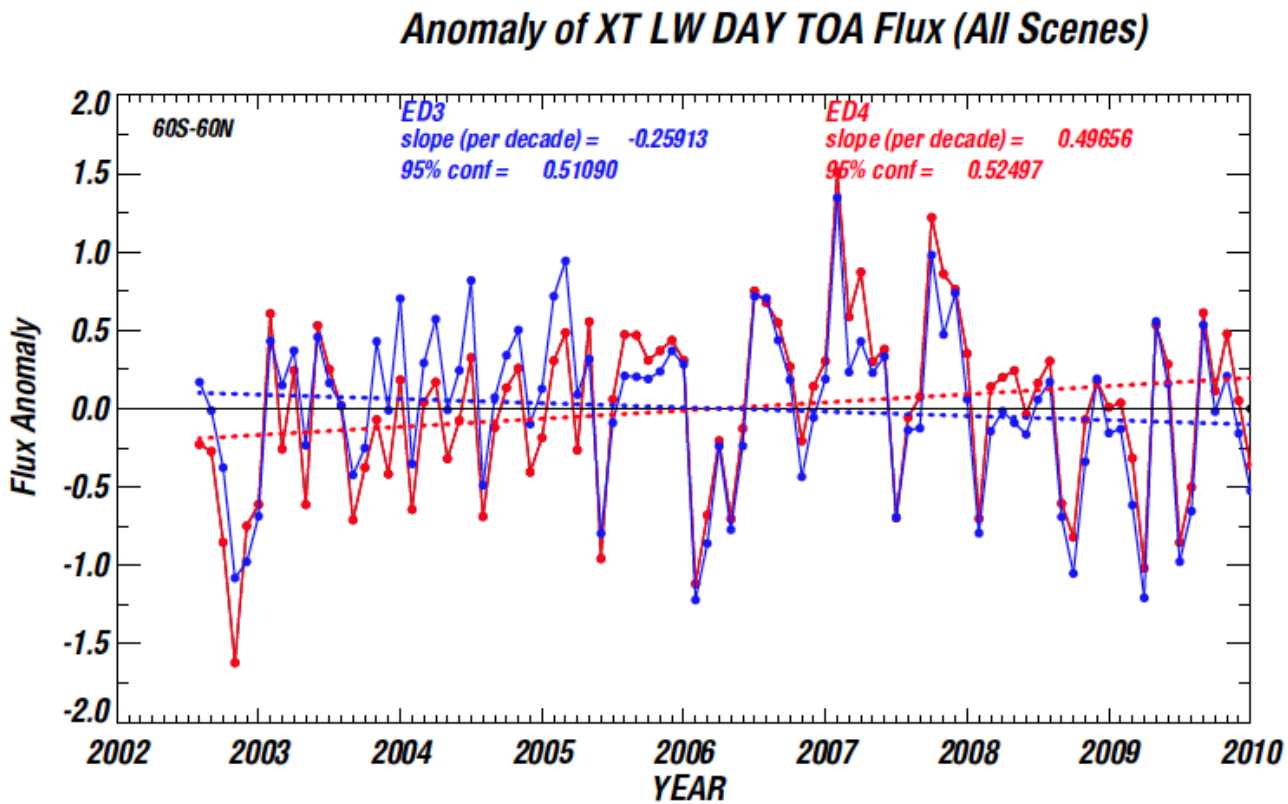
Aqua X-Track EDITION-3 and 4 SW Comparison



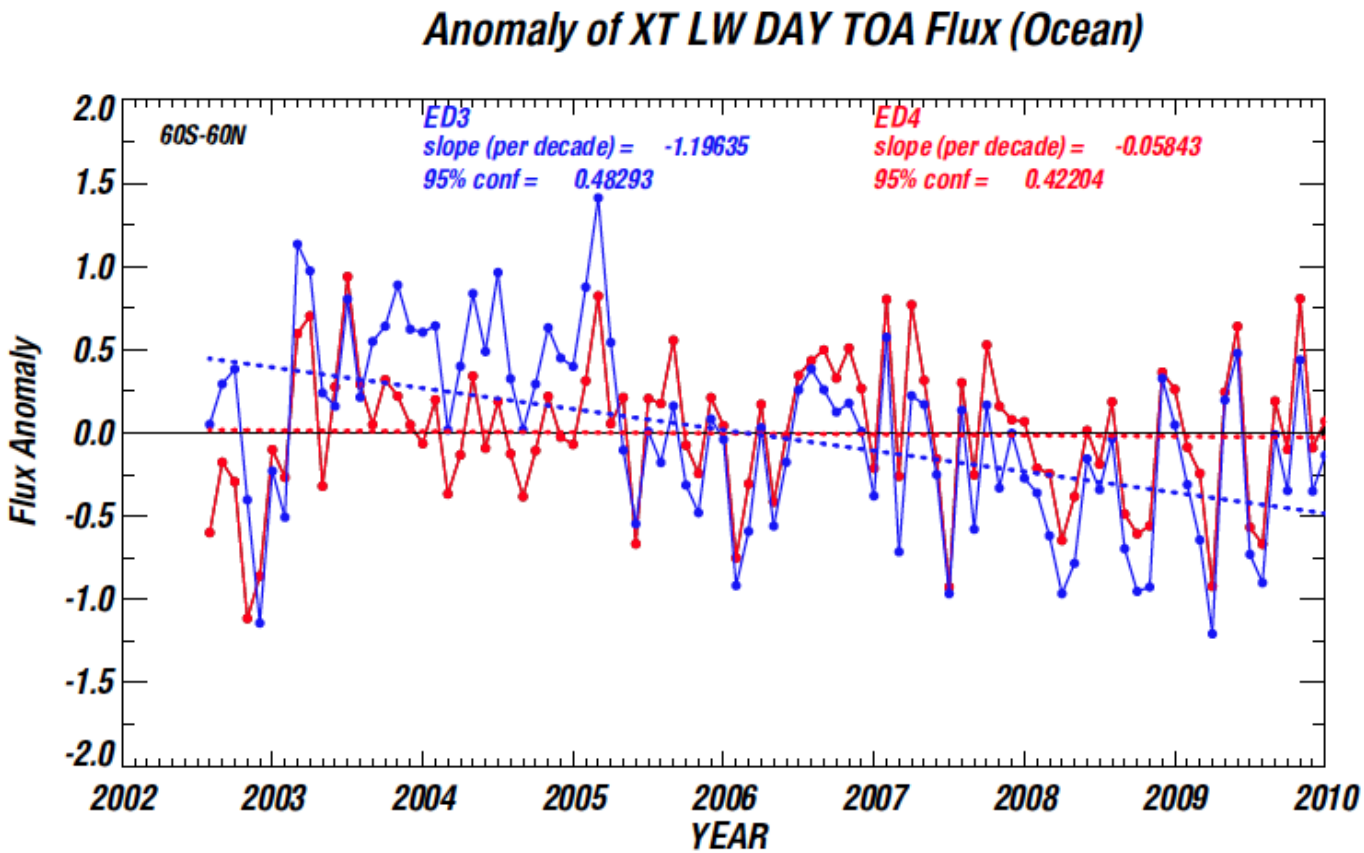
Aqua X-Track EDITION-3 and 4 SW Comparison



Aqua X-Track EDITION-3 and 4 LW Comparison



Aqua X-Track EDITION-3 and 4 LW Comparison



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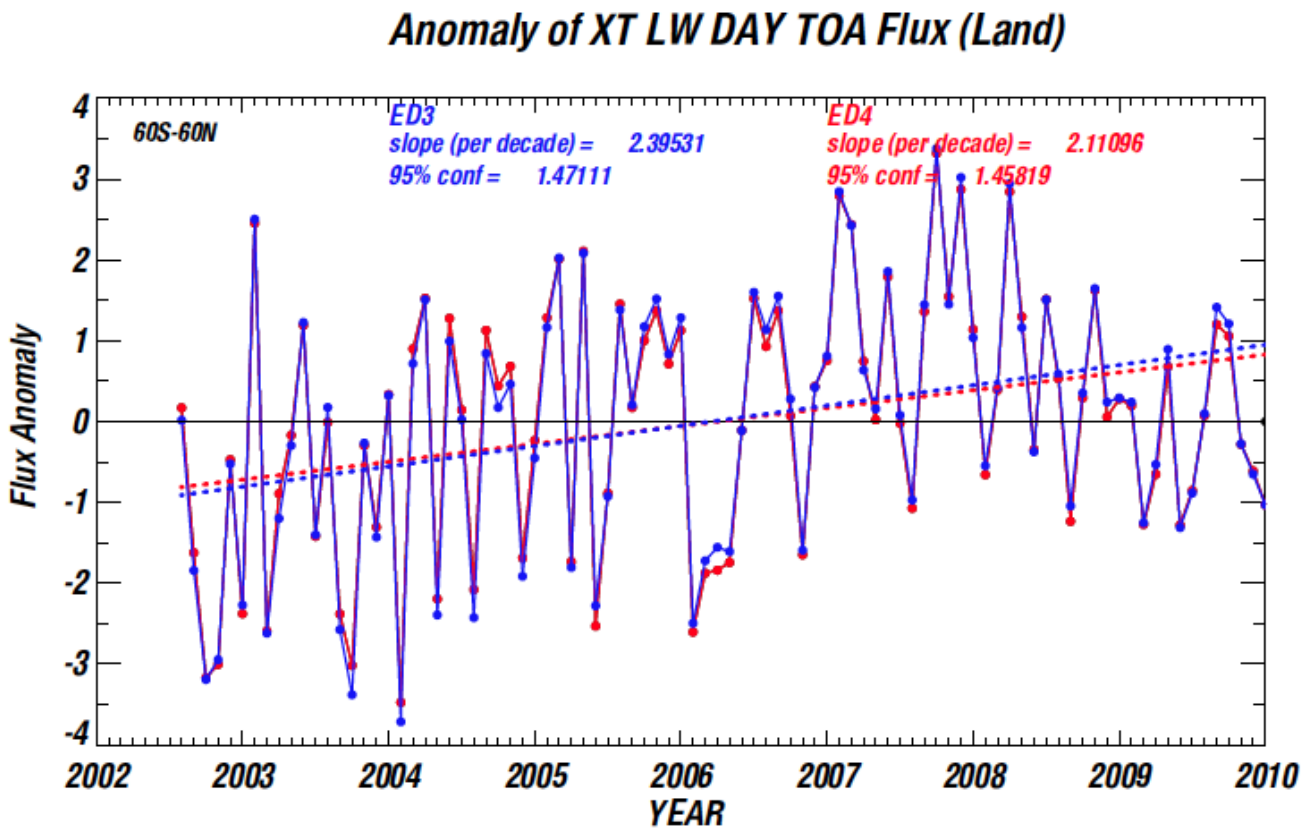


Inter-Comparison Campaigns – Summer 2013

- CERES Terra/FM1 – NPP/CERES FM5

  Duration: May 1 to July 31. Comparison Region: ~68° N

  Minor plane scanning with 2-3 orbital crossing/day of 3 minute duration. Time differential between co-located footprint < 5 minutes

- CERES Terra/FM1 – Aqua/FM3

  Duration: June 1 – 30, 2013. Comparison Region: ~68° N

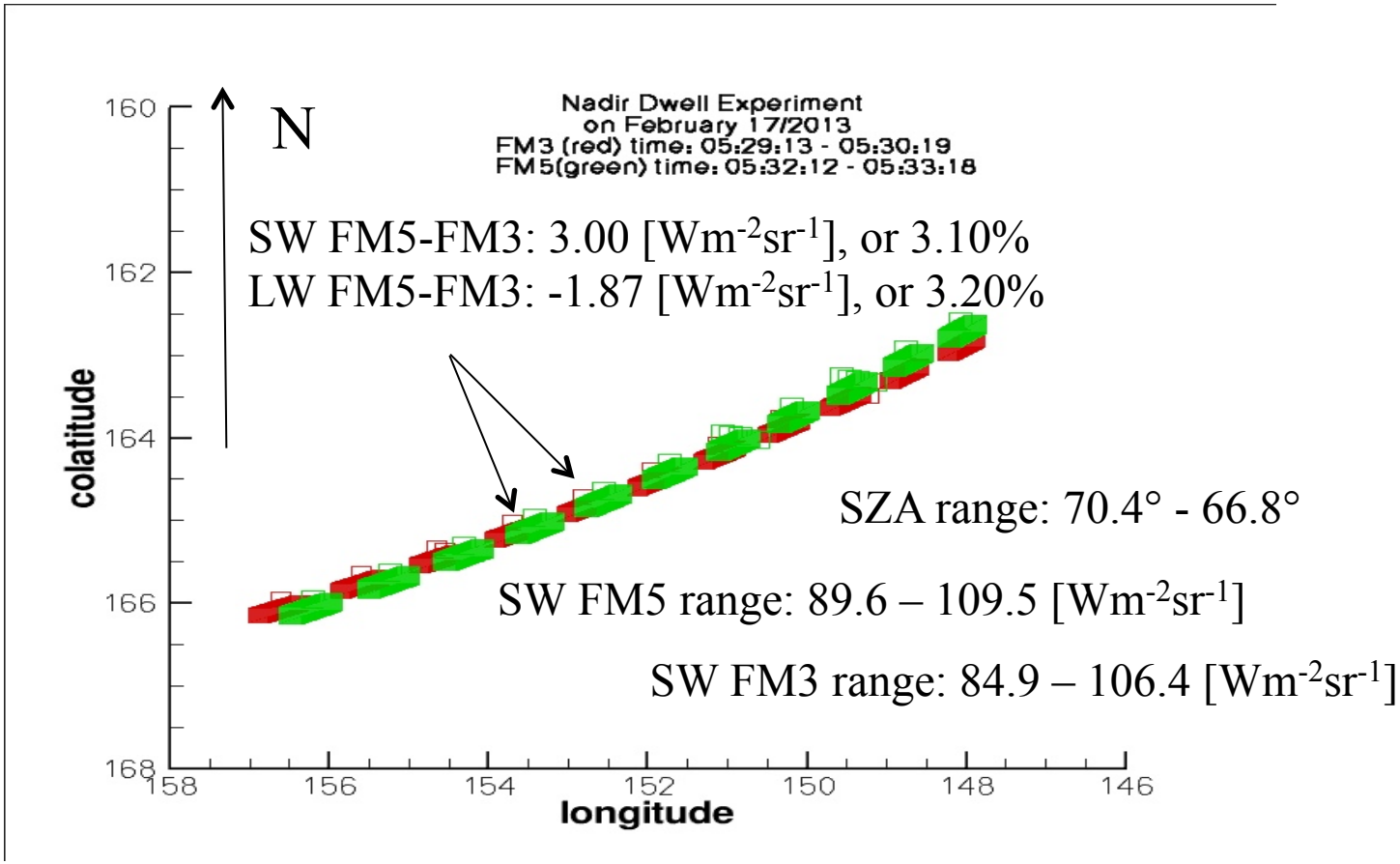
  Minor plane scanning with 15 orbital crossing/day. Time differential between co-located footprint < 18 minutes

- CERES Terra/FM2 – GERB

  Duration: June 1 – 30, 2013

SUMMARY

- Performance trends of S-NPP/CERES FM5 instrument are within the normal range.
- CERES FM5 gains for Edition1 processing is in testing/validation.
- Delivery of Instrument Gains and SRFs for the Edition4 processing. Terra/FM1 & FM2 were delivered. Aqua/FM3 & FM4 are in validation.

BACK UP SLIDES

Nadir dwell scanning on 02/17 over Antarctica